

a plurality of low-level controllers coupled to the at least one mid-level controller;  
in response to commands from a respective mid-level controller, each of the low-level controllers being configured to control directly a respective group of one or more electromechanical devices, the group being selected from a plurality of electromechanical devices composing the material transport system;

the respective mid-level controller being configured to formulate the commands in accordance with local goals formulated for the respective mid-level controller by the top-level controller;

the top-level controller being configured to formulate the local goals in accordance with a global goal for a transfer operation pending in the material transport system.

2. (Unchanged) The distributed control system of claim 1, wherein, when the global goal comprises a transfer command requesting movement of a particular package from one station of the material transport system to another station, the high-level controller determines a sequence of the local goals necessary to implement the transfer command and issues the local goals to the mid-level controller.

3. (Unchanged) The distributed control system of claim 2, wherein the local goals comprise a series of acquire, move and deposit commands that are executed by at least one of the mid-level controllers.

4. (Unchanged) The distributed control system of claim 1, wherein the material transport system comprises a transport system employed in a semiconductor fabrication facility to move at least one of:

- one or more semiconductor wafers between processing stations;
- one or more semiconductor wafers between the processing and metrology stations;
- one or more semiconductor wafers between the metrology stations;
- one or more reticles to respective ones of the processing stations.

5. (Amended) The distributed control system of claim 4, wherein the electromechanical devices comprise at least one of:

a zone including a length of track, at least one drive motor for driving a pod containing said wafers along the track, and at least one sensor for sensing presence of the pod within the zone;

a director for providing rotational movement between at least two zones whose track portions meet at other than a 180 degree angle; and

a Load Port Transfer Device (LPTD) for coordinating the pod into and out of the load zone.

6. (Unchanged) The distributed control system of claim 1, wherein the material transport system comprises a transport system employed in a manufacturing facility selected from a flat panel display manufacturing facility, a magnetic storage disk drive manufacturing facility or a pharmaceutical manufacturing facility, such that:

when used in the flat panel display manufacturing facility, the material transport system is used to move flat panels between flat panel components between flat panel manufacturing stations;

when used in the magnetic storage disk drive manufacturing facility, the material transport system is used to move magnetic storage disks between disk drive manufacturing stations; and

when used in the pharmaceutical manufacturing facility, the material transport system is used to move pharmaceutical components between pharmaceutical manufacturing stations.

7. (Unchanged) A method of configuring a distributed control system for a material transport system, comprising:

defining a set of neighborhoods including electromechanical devices composing the material transport system, wherein each of the neighborhoods includes the electromechanical devices that are likely to interact based on topology of the material transport system;

providing a low-level controller for the electromechanical devices, the low-level controllers being configured to translate generalized control commands to low-level control commands for the respective electromechanical device and to report status of the respective electromechanical device;

providing a higher-level controller that controls all low-level controllers associated with at least one of the neighborhoods via the generalized control commands;

compartmentalizing processing within the higher-level controller so that information regarding no more than the electromechanical devices composing the associated neighborhood is used to formulate the generalized control commands for low-level controllers associated with that one neighborhood.

8. (Unchanged) A computer program product for use in a material transport system including a plurality of electromechanical devices and a control computer, wherein the computer program product includes a computer memory coupled to the control computer and a computer mechanism defined therein, the computer mechanism comprising:

control threads that configure the control computer to control and monitor operations of the electromechanical devices;

one of the control threads associated with a particular electromechanical device communicating with others of the control threads associated with a group of electromechanical devices that interact with the particular electromechanical device so that the one control thread and the others cooperatively accomplish a goal involving movement of material using the particular electromechanical device and the group of electromechanical devices.

9. (Unchanged) The computer program product of claim 8, wherein:

the particular electromechanical device is a particular track zone and the group of electromechanical devices are other track zones neighboring the particular track zone, each of the track zones being configured to accelerate the material;

such that the one thread causes the particular track zone to accelerate the material to a target value, determines a set of future target values to which the material should be accelerated by the other track zones, and issues commands to the others of the control threads indicating respective ones of the set of future target values.

10. (Unchanged) The computer program product of claim 8, wherein the particular electromechanical device and the group of electromechanical devices form a neighborhood of the electromechanical devices likely to interact during operations of the material transport system.

11. (Unchanged) The computer program product of claim 8, wherein:  
the material comprises a plurality of material units;  
movement of each of the material units is independently controlled by the control threads;  
and  
the control threads are configured so that the control threads that control the electromechanical devices composing a particular neighborhood in which a plurality of the material units are simultaneously moving can cooperatively accomplish a goal involving movement of the multiple material units towards respective destinations without collisions occurring.

Please cancel Claims 12 through 18.

19. (Amended) A distributed method for routing material from a source to a destination in a material transport system including track zones and directors connecting the track zones, wherein the directors include routing tables that store routing information in the form of distance data for a plurality of routes across the material transport system to a destination, the method comprising:

launching the material from the source;

when the material enters a track neighborhood that includes a director through which the material must pass to proceed to the destination, notifying the director of the approach of the material;

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continued  
the director, in response to the notifying, selecting an optimal route for the material based on the destination and stored routing information indicating for each material transport system destination a director exit angle and a metric characterizing quality of a path to the destination originating from the director exit angle; and

the director subsequently decelerating the material, rotating to the director exit angle associated with the optimal route and relaunching the material along the optimal route.

20. (Unchanged) The distributed method of claim 19, further comprising:  
modifying the stored routing information to account for routes that become unavailable during operation of the material transport system.

21. (Unchanged) The distributed method of claim 20, wherein a route becomes unavailable due to:

failure of the route's destination;  
failure of a track zone between the director and the route's destination;  
failure of one or more intervening directors between the director and the route's destination; and  
disablement of the route by a material transport system operator.

22. (Unchanged) The distributed method of claim 19, wherein the metric associated with a particular exit angle and destination is determined for a new director as follows:

(1) the new director sends a path query to an immediate downstream neighbor at the particular exit angle;

(2) in response to the path query:

(2a) when the immediate downstream neighbor is the destination: the destination increments the metric to indicate the quality of the route to the destination and returns the incremented metric to the new director;

(2b) when the immediate downstream neighbor is a track zone: the track zone increments the metric to indicate the quality of the route through the track zone to the destination, resends the path query with the incremented metric to an immediate downstream neighbor of the track zone, which repeats operation (2); and

(2c) when the immediate downstream neighbor is another director: the other director increments the metric to indicate quality of the route from the other director to the destination and returns the incremented metric to the new director.

23. (Unchanged) The distributed method of claim 19, wherein the metric is a function of at least one of:

route length;  
route transit time; and  
route congestion.

24. (Unchanged) The distributed method of claim 19, further comprising:

(1) when a new destination is added to the material transfer system, the new destination announces its presence to its immediate upstream neighbor using a dest\_announce message;

(2) in response to the dest\_announce message:

(2a) when the immediate upstream neighbor is a track zone, the track zone increments a metric associated with the announce message that characterizes quality of a path from the new destination to the immediate upstream neighbor, resends the announce message with the updated metric to an immediate upstream neighbor of the track zone, which repeats operation (2);

(2b) when the immediate upstream neighbor is a first director: the first director increments the metric to indicate quality of the route from the first director to the new destination, stores the metric along with the exit angle and identify of the new destination and returns a registered message informing the new destination that it has been registered.

25. (Unchanged) The distributed method of claim 24, further comprising, when the immediate upstream neighbor is the first director:

the first director announces the new destination to adjacent directors with route\_announce messages indicating a cumulative metric representing the metric from the first director to the new destination and the metric between the first director and respective ones of the adjacent directors;

repeating an operation wherein each of the adjacent directors updates their stored information for an appropriate exit angle with the cumulative metric and resends the route\_announce message to their adjacent directors until the route\_announce message arrives back at the first director.

26. (Unchanged) The distributed method of claim 19, wherein the stored information for each of the routes comprises:

the destination;

the exit direction;

whether the route is direct, meaning there are no intervening directors, or via, meaning there is at least one intervening director;

the metric characterizing goodness of the route; and

the route status.

27. (Unchanged) The distributed method of claim 19, further comprising:

when the material comprises two or more material units moving in one neighborhood in need of routing through the director, the track zones cooperatively route the material units to the